

IN THE CLAIMS:

1. (Previously Amended) A semiconductor device manufacturing method comprising the steps of:

exposing a surface of a copper wiring layer to a NH_3 plasma to remove surface oxide from the copper wiring layer;

then converting into a plasma a process gas selected from the group consisting of N_2 , N_2O and mixtures thereof; and

D' nitriding a surface portion of the copper wiring layer to convert the surface portion into a copper diffusion preventing layer by exposing the surface of the copper wiring layer to the process gas plasma.

2. (Previously cancelled)

3. (Previously Amended) A semiconductor device manufacturing method according to claim 26, wherein the hydrocarbon is CH_4 or C_2H_2 .

4. (Amended) A semiconductor device manufacturing method comprising the steps of:

converting to a plasma a process gas consisting of N_2 and NH_3 ;

nitriding a surface portion of a copper wiring layer to convert the surface portion into a copper diffusion preventing layer by exposing a surface of the copper wiring layer to the process gas plasma; and

then forming a SiOCH ~~SiO₂~~ film on the copper wiring layer to prevent copper diffusion from the copper wiring layer.

5. (Cancelled)

6. (Previously Amended) A semiconductor device manufacturing method according to claim 1, further comprising the step of:

forming a silicon-containing insulating film on the copper wiring layer after the surface portion of the copper wiring layer has been nitrided.

7. (Previously Amended) A semiconductor device manufacturing method according to claim 6, further comprising the steps of:

converting a process gas containing at least one of NH₃, N₂, and N₂O into a second process gas plasma; and

after forming the silicon-containing insulating film, exposing the silicon-containing insulating film to the second process gas plasma.

8. (Previously Amended) A semiconductor device manufacturing method according to claim 6, further comprising the steps of:

forming an interlayer insulating film on the silicon-containing insulating film;

forming a via hole in the silicon-containing insulating film and the interlayer insulating film;

burying a plug connected electrically to the copper wiring layer in the via hole; and
forming an upper wiring layer, connected electrically to the plug, on the interlayer
insulating film.

9. (Previously cancelled)

10. (Previously cancelled)

11. (Previously cancelled)

12. (Previously Amended) A semiconductor device manufacturing method according to claim 8,
wherein the interlayer insulating film is a FSG film or a porous SiO₂ film.

13. (Cancelled)

Claims 14-25 (Previously cancelled)

26. (Previously Amended) A semiconductor device manufacturing method comprising the steps
of:

exposing a surface of a copper wiring layer to a NH₃ plasma to remove surface oxide
from the copper wiring layer;

then converting into a plasma a process gas made by adding a hydrocarbon C_xH_y to a gas

selected from the group consisting of N_2 , N_2O and mixtures thereof; and

nitriding a surface portion of the copper wiring layer to convert the surface portion into a copper diffusion preventing layer by exposing the surface of the copper wiring layer to the process gas plasma.

27. (Amended) A semiconductor device manufacturing method comprising the steps of:

converting into a plasma a process gas selected from the group consisting of N_2 , N_2O and mixtures thereof;

nitriding a surface portion of a copper wiring layer to convert the surface portion into a copper diffusion preventing layer by exposing a surface of the copper wiring layer to the process gas plasma; and

then forming, on the copper wiring layer, a SiOCH ~~SiO₂~~ film for preventing copper diffusion from the copper wiring layer.

28. (Amended) A semiconductor device manufacturing method comprising the steps of:

converting to a plasma a process gas made by adding a hydrocarbon C_xH_y to a gas selected from the group consisting of N_2 , N_2O and mixtures thereof;

nitriding a surface portion of a copper wiring layer to convert the surface portion into a copper diffusion preventing layer by exposing the surface portion of the copper wiring layer to the process gas plasma; and

then forming, on the copper wiring layer, a SiOCH ~~SiO₂~~ film for preventing copper diffusion from the copper wiring layer.